Review of Pulsar UL Paper for S1

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- Review Team met with PULG before paper was defined
- Problem – few GW sources are less likely to yield a signal in S1 data than are the known pulsars
- Opportunity – frequency and time domain techniques, frequentist and Bayesian limit setting have applicability for less biased searches in future; let's use S1 data to demonstrate and compare techniques on a single known pulsar in a single paper
- S2 will be more interesting than S1, so try to fit scope to schedule

General Features

- Envisioned as PRD paper emphasizing methods with real data
- It's a long paper, well structured and written
- Still needs some polishing, but not much
- Commend pulsar group for rapidly putting this together – many reiterations of data analysis were asked for and done recently
- Closest LIGO-GEO connection of any of the analyses

Scope of the Paper

- Set the stage
- Characterize signal and data
- Frequency-domain analysis w/ frequentist UL
- Time domain analysis w/ Bayesian UL
- Combined-detector UL using Bayesian approach
- Compare the techniques
- How this work compares to other work

- Reviewers believe paper is mature and substantively valid

What We (Reviewers) Did

- Questioned statistical methods
- Asked about additional checks of timing routines
- Asked about additional internal consistency checks
- Fact-checked paper
- Suggested clarifications to paper

Why We Believe Pulsar Results Are Sensible?

- Values of $S_h(f)$ agree with typical calibrated spectra
  - » Rules out problems of normalizations, competing conventions
- Extensive use was made of signal injections
  - » Different codes and people did the injecting and extracting
- Timing residuals between LAL barycenter routines and radio-astronomy package TEMPO are ~ few μs
  - » We know the earth is moving in the right direction
- Both a Bayesian time domain UL and a frequency domain frequentist UL are extremely close
- Back of the envelope derivation of UL is close (sqrt(2)) to detailed ULs obtained by both techniques
- Noise well characterized
  - » ULs compare reasonably with injected signals
  - » Extensive Monte-Carlo characterization for frequency domain
  - » Rough agreement with gaussian statistics

Comparison of Upper Limits

IFO	Frequentist FDS (worst)	Frequentist FDS (uniform)	Bayesian TDS (uniform)	Quickie 90%CL
L1	2.8×10^{-22}	1.5×10^{-22}	1.4×10^{-22}	1.9×10^{-22}

Further Issues

- Errors on upper limits: how are they arrived at?
- Average noise plots for H1, H2 seem to be dominated by a small number of periods of high noise – why?
- There's a discussion of H2 sometimes having "pathological" calibration info, yet these time periods are included in the baseline analysis
- Advanced LIGO is mentioned in passing (e.g. design sensitivity curve), but not described
- Is the paper trail sufficient?